

I 650M
Tier 2
Crawler Dozer
PIN NGC107000 and above

SERVICE MANUAL

Part number 48048568

1st edition English

April 2017





SERVICE MANUAL

1650M Bulldozer (BD) Blade, Extra Long Track (XLT) - Tier 2 [NGC107000 -]
1650M Power Angle Tilt (PAT) Blade, Extra Long Track (XLT) - Tier 2
[NGC107000 -]
1650M Power Angle Tilt (PAT) Blade, Low Ground Pressure (LGP) - Tier 2
[NGC107000 -]

Contents

INTRODUCTION

Engine.....	10
[10.001] Engine and crankcase	10.1
[10.202] Air cleaners and lines	10.2
[10.206] Fuel filters	10.3
[10.304] Engine lubrication system.....	10.4
[10.310] Aftercooler.....	10.5
[10.400] Engine cooling system	10.6
[10.414] Fan and drive	10.7
Hydrostatic drive.....	29
[29.218] Pump and motor components.....	29.1
Brakes and controls	33
[33.110] Parking brake or parking lock	33.1
[33.202] Hydraulic service brakes	33.2
Hydraulic systems.....	35
[35.000] Hydraulic systems.....	35.1
[35.300] Reservoir, cooler, and filters.....	35.2
[35.104] Fixed displacement pump.....	35.3
[35.105] Charge pump.....	35.4
[35.359] Main control valve	35.5
[35.741] Dozer blade cylinders	35.6
Tracks and track suspension	48
[48.130] Track frame and driving wheels.....	48.1
[48.100] Tracks	48.2
[48.134] Track tension units	48.3
[48.138] Track rollers	48.4

[48.140] Dropbox and final drive	48.5
[48.AAA] Tracks and track suspension generic sub-group	48.6
Cab climate control	50
[50.100] Heating	50.1
[50.104] Ventilation	50.2
[50.200] Air conditioning	50.3
Electrical systems	55
[55.000] Electrical system	55.1
[55.011] Fuel tank system	55.2
[55.014] Engine intake and exhaust system	55.3
[55.015] Engine control system	55.4
[55.030] Service brake electrical system	55.5
[55.050] Heating, Ventilation, and Air-Conditioning (HVAC) control system	55.6
[55.100] Harnesses and connectors	55.7
[55.201] Engine starting system	55.8
[55.202] Cold start aid	55.9
[55.301] Alternator	55.10
[55.302] Battery	55.11
[55.408] Warning indicators, alarms, and instruments	55.12
[55.512] Cab controls	55.13
[55.518] Wiper and washer system	55.14
[55.DTC] FAULT CODES	55.15
Dozer blade and arm	86
[86.110] Dozer blade	86.1
[86.124] Dozer pushbeams and struts	86.2
Tools	89
[89.128] Ripper assembly	89.1
Platform, cab, bodywork, and decals	90

[90.160] Cab interior trim and panels..... 90.1

[90.124] Pneumatically-adjusted operator seat..... 90.2

[90.100] Engine hood and panels 90.3



INTRODUCTION

Contents

INTRODUCTION

Foreword - Important notice regarding equipment servicing (*)	3
Safety rules (*)	4
Safety rules - Personal safety (*)	5
Safety rules - Ecology and the environment (*)	7
Safety rules - Do not operate tag (*)	8
Torque - Minimum tightening torques for normal assembly (*)	9
Torque - Standard torque data for hydraulics (*)	14
Torque - Standard torque data for hydraulic connections (*)	30
Torque - Special torques (*)	37
Basic instructions - Shop and assembly (*)	39
Engine cooling system - Basic instructions (*)	41
Maintenance chart	43
Basic instructions - Moving a disabled machine (*)	45
Hydraulic contamination (*)	54
Consumables Loctite® Product Chart (*)	55
Conversion factors (*)	61
General specification (*)	63
Capacities	67
General specification	68
Product identification	70
Product identification - Machine orientation	73

(*) See content for specific models

Foreword - Important notice regarding equipment servicing

1650M

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All repair and maintenance work listed in this manual must be carried out only by qualified dealership personnel, strictly complying with the instructions given, and using, whenever possible, the special tools.

Anyone who performs repair and maintenance operations without complying with the procedures provided herein shall be responsible for any subsequent damages.

The manufacturer and all the organizations of its distribution chain, including - without limitation - national, regional, or local dealers, reject any responsibility for damages caused by parts and/or components not approved by the manufacturer, including those used for the servicing or repair of the product manufactured or marketed by the manufacturer. In any case, no warranty is given or attributed on the product manufactured or marketed by the manufacturer in case of damages caused by parts and/or components not approved by the manufacturer.

The manufacturer reserves the right to make improvements in design and changes in specifications at any time without notice and without incurring any obligation to install them on units previously sold. Specifications, descriptions, and illustrative material herein are as accurate as known at time of publication but are subject to change without notice.

In case of questions, refer to your CASE CONSTRUCTION Sales and Service Networks.

Safety rules

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Personal safety



This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible death or injury.

Throughout this manual you will find the signal words DANGER, WARNING, and CAUTION followed by special instructions. These precautions are intended for the personal safety of you and those working with you.

Read and understand all the safety messages in this manual before you operate or service the machine.

 DANGER indicates a hazardous situation that, if not avoided, will result in death or serious injury.

 WARNING indicates a hazardous situation that, if not avoided, could result in death or serious injury.

 CAUTION indicates a hazardous situation that, if not avoided, could result in minor or moderate injury.

FAILURE TO FOLLOW DANGER, WARNING, AND CAUTION MESSAGES COULD RESULT IN DEATH OR SERIOUS INJURY.

Machine safety

NOTICE: Notice indicates a situation that, if not avoided, could result in machine or property damage.

Throughout this manual you will find the signal word Notice followed by special instructions to prevent machine or property damage. The word Notice is used to address practices not related to personal safety.

Information

NOTE: Note indicates additional information that clarifies steps, procedures, or other information in this manual.

Throughout this manual you will find the word Note followed by additional information about a step, procedure, or other information in the manual. The word Note is not intended to address personal safety or property damage.

Safety rules - Personal safety

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General maintenance safety

Keep area used for servicing the machine clean and dry. Clean up spilled fluids.

Service machine on a firm level surface.

Install guards and shields after servicing the machine.

Close all access doors and install all panels after servicing the machine.

Do not attempt to clean, lubricate, clear obstructions or make adjustments to the machine while it is in motion or while the engine is running.

Always make sure working area is clear of tools, parts, other persons and pets before you start operating the machine.

Unsupported hydraulic cylinders can lose pressure and drop the equipment causing a crushing hazard. Do not leave equipment in a raised position while parked or during service, unless securely supported.

Jack or lift the machine only at jack or lift points indicated in this manual.

Incorrect towing procedures can cause accidents. When towing a disabled machine follow the procedure in this manual. Use only rigid tow bars.

Stop the engine, remove key and relieve pressure before disconnecting or connecting fluid lines.

Stop the engine and remove key before disconnecting or connecting electrical connections.

Scalding can result from incorrect removal of coolant caps. Cooling system operates under pressure. Hot coolant can spray out if a cap is removed while the system is hot. Allow system to cool before removing cap. When removing a cap turn it slowly to allow pressure to escape before completely removing the cap.

Replace damaged or worn tubes, hoses, electrical wiring, etc.

Engine, transmission, exhaust components, and hydraulic lines may become hot during operation. Take care when servicing such components. Allow surfaces to cool before handling or disconnecting hot components. Wear protective equipment when appropriate.

When welding, follow the instructions in the manual. Always disconnect the battery before welding on the machine. Always wash your hands after handling battery components.

General battery safety

Always wear eye protection when working with batteries.

Do not create sparks or have open flame near battery.

Ventilate when charging or using in an enclosed area.

Disconnect negative (-) first and reconnect negative (-) last.

When welding on the machine, disconnect both terminals of the battery.

Do not weld, grind, or smoke near a battery.

When using auxiliary batteries or connecting jumper cables to start the engine, use the procedure shown in the operator's manual. Do not short across terminals.

Follow manufacturer's instructions when storing and handling batteries.

Battery post, terminals, and related accessories contain lead and lead compounds. Wash hands after handling. This is a California Proposition 65 warning.

Battery acid causes burns. Batteries contain sulfuric acid. Avoid contact with skin, eyes, or clothing. Antidote (external): Flush with water. Antidote (eyes): flush with water for 15 minutes and seek medical attention immediately. Antidote (internal): Drink large quantities of water or milk. Do not induce vomiting. Seek medical attention immediately.

Keep out of reach of children and other unauthorized persons.

Air-conditioning system

The air-conditioning system is under high pressure. Do not disconnect any lines. The release of high pressure can cause serious injury.

The air-conditioning system contains gases that are harmful to the environment when released into the atmosphere. Do not attempt to service or repair the system.

Service, repair, or recharging must be performed only by a trained service technician.

Personal Protective Equipment (PPE)

Wear Personal Protective Equipment (PPE) such as hard hat, eye protection, heavy gloves, hearing protection, protective clothing, etc.

Do Not Operate tag

Before you start servicing the machine, attach a 'Do Not Operate' warning tag to the machine in an area that will be visible.

Safety rules - Ecology and the environment

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Soil, air, and water quality is important for all industries and life in general. When legislation does not yet rule the treatment of some of the substances that advanced technology requires, sound judgment should govern the use and disposal of products of a chemical and petrochemical nature.

Familiarize yourself with the relative legislation applicable to your country, and make sure that you understand this legislation. Where no legislation exists, obtain information from suppliers of oils, filters, batteries, fuels, anti-freeze, cleaning agents, etc., with regard to the effect of these substances on man and nature and how to safely store, use, and dispose of these substances.

Helpful hints

- Avoid the use of cans or other inappropriate pressurized fuel delivery systems to fill tanks. Such delivery systems may cause considerable spillage.
- In general, avoid skin contact with all fuels, oils, acids, solvents, etc. Most of these products contain substances that may be harmful to your health.
- Modern oils contain additives. Do not burn contaminated fuels and or waste oils in ordinary heating systems.
- Avoid spillage when you drain fluids such as used engine coolant mixtures, engine oil, hydraulic fluid, brake fluid, etc. Do not mix drained brake fluids or fuels with lubricants. Store all drained fluids safely until you can dispose of the fluids in a proper way that complies with all local legislation and available resources.
- Do not allow coolant mixtures to get into the soil. Collect and dispose of coolant mixtures properly.
- The air-conditioning system contains gases that should not be released into the atmosphere. Consult an air-conditioning specialist or use a special extractor to recharge the system properly.
- Repair any leaks or defects in the engine cooling system or hydraulic system immediately.
- Do not increase the pressure in a pressurized circuit as this may lead to a component failure.
- Protect hoses during welding. Penetrating weld splatter may burn a hole or weaken hoses, allowing the loss of oils, coolant, etc.

Battery recycling

Batteries and electric accumulators contain several substances that can have a harmful effect on the environment if the batteries are not properly recycled after use. Improper disposal of batteries can contaminate the soil, groundwater, and waterways. CASE CONSTRUCTION strongly recommends that you return all used batteries to a CASE CONSTRUCTION dealer, who will dispose of the used batteries or recycle the used batteries properly. In some countries, this is a legal requirement.



Mandatory battery recycling

NOTE: The following requirements are mandatory in Brazil.

Batteries are made of lead plates and a sulfuric acid solution. Because batteries contain heavy metals such as lead, CONAMA Resolution 401/2008 requires you to return all used batteries to the battery dealer when you replace any batteries. Do not dispose of batteries in your household garbage.

Points of sale are obliged to:

- Accept the return of your used batteries
- Store the returned batteries in a suitable location
- Send the returned batteries to the battery manufacturer for recycling

Safety rules - Do not operate tag

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⚠ WARNING

Maintenance hazard!

Before you start servicing the machine, attach a DO NOT OPERATE warning tag to the machine in a visible area.

Failure to comply could result in death or serious injury.

W0004A

Attach a DO NOT OPERATE (TAG) to the machine in an area that is clearly visible whenever the machine is not operating properly and/or requires service.

Complete the tag information for the "REASON" the tag is attached by describing the malfunction or service required. Validate the reason for attaching the tag by signing your name in the designated area on the tag.

The tag should only be removed by the person who signed and attached the tag, after validating the repairs or services have been completed.

	⊕	
(A)	DO NOT REMOVE THIS TAG!	(D)
(B)	See Other Side 	(E)
(C)	CNH Part Number 87358697 Printed in U.S.A.	(F)
	DO NOT OPERATE REASON _____ _____ _____ _____ _____ Signed by _____	
	⊕	

87358697 1

Tag Components

- A. DO NOT REMOVE THIS TAG! - (Warning) The tag should only be removed by the person who signed and attached the tag, after validating the repairs or services have been completed.
- B. See Other Side - (Reference to additional information on opposite side of the tag.)
- C. CNH Part Number - (Request this part number from you Service Parts Dealer to obtain this DO NOT OPERATE tag.)
- D. DO NOT OPERATE - (Warning!)
- E. REASON - (Area for describing malfunction or service required before operation.)
- F. Signed by - (Signature area - to be signed by the person validating the reason for installation of the tag.)

Torque - Minimum tightening torques for normal assembly

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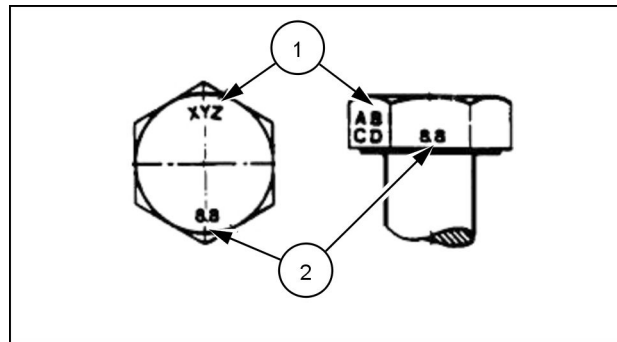
METRIC NON-FLANGED HARDWARE

NOM. SIZE	CLASS 8.8 BOLT and CLASS 8 NUT		CLASS 10.9 BOLT and CLASS 10 NUT		LOCKNUT CL.8 W/CL8.8 BOLT	LOCKNUT CL.10 W/CL10.9 BOLT
	UNPLATED	PLATED W/ZnCr	UNPLATED	PLATED W/ZnCr		
M4	2.2 N·m (19 lb in)	2.9 N·m (26 lb in)	3.2 N·m (28 lb in)	4.2 N·m (37 lb in)	2 N·m (18 lb in)	2.9 N·m (26 lb in)
M5	4.5 N·m (40 lb in)	5.9 N·m (52 lb in)	6.4 N·m (57 lb in)	8.5 N·m (75 lb in)	4 N·m (36 lb in)	5.8 N·m (51 lb in)
M6	7.5 N·m (66 lb in)	10 N·m (89 lb in)	11 N·m (96 lb in)	15 N·m (128 lb in)	6.8 N·m (60 lb in)	10 N·m (89 lb in)
M8	18 N·m (163 lb in)	25 N·m (217 lb in)	26 N·m (234 lb in)	35 N·m (311 lb in)	17 N·m (151 lb in)	24 N·m (212 lb in)
M10	37 N·m (27 lb ft)	49 N·m (36 lb ft)	52 N·m (38 lb ft)	70 N·m (51 lb ft)	33 N·m (25 lb ft)	48 N·m (35 lb ft)
M12	64 N·m (47 lb ft)	85 N·m (63 lb ft)	91 N·m (67 lb ft)	121 N·m (90 lb ft)	58 N·m (43 lb ft)	83 N·m (61 lb ft)
M16	158 N·m (116 lb ft)	210 N·m (155 lb ft)	225 N·m (166 lb ft)	301 N·m (222 lb ft)	143 N·m (106 lb ft)	205 N·m (151 lb ft)
M20	319 N·m (235 lb ft)	425 N·m (313 lb ft)	440 N·m (325 lb ft)	587 N·m (433 lb ft)	290 N·m (214 lb ft)	400 N·m (295 lb ft)
M24	551 N·m (410 lb ft)	735 N·m (500 lb ft)	762 N·m (560 lb ft)	1016 N·m (750 lb ft)	501 N·m (370 lb ft)	693 N·m (510 lb ft)

NOTE: M4 through M8 hardware torque specifications are shown in pound-inches. M10 through M24 hardware torque specifications are shown in pound-feet.

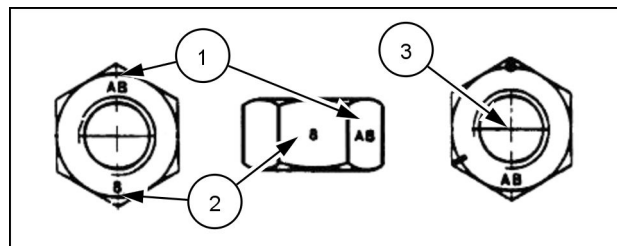
METRIC FLANGED HARDWARE

NOM. SIZE	CLASS 8.8 BOLT and CLASS 8 NUT		CLASS 10.9 BOLT and CLASS 10 NUT		LOCKNUT CL.8 W/CL8.8 BOLT	LOCKNUT CL.10 W/CL10.9 BOLT
	UNPLATED	PLATED W/ZnCr	UNPLATED	PLATED W/ZnCr		
M4	2.4 N·m (21 lb in)	3.2 N·m (28 lb in)	3.5 N·m (31 lb in)	4.6 N·m (41 lb in)	2.2 N·m (19 lb in)	3.1 N·m (27 lb in)
M5	4.9 N·m (43 lb in)	6.5 N·m (58 lb in)	7.0 N·m (62 lb in)	9.4 N·m (83 lb in)	4.4 N·m (39 lb in)	6.4 N·m (57 lb in)
M6	8.3 N·m (73 lb in)	11 N·m (96 lb in)	12 N·m (105 lb in)	16 N·m (141 lb in)	7.5 N·m (66 lb in)	11 N·m (96 lb in)
M8	20 N·m (179 lb in)	27 N·m (240 lb in)	29 N·m (257 lb in)	39 N·m (343 lb in)	18 N·m (163 lb in)	27 N·m (240 lb in)
M10	40 N·m (30 lb ft)	54 N·m (40 lb ft)	57 N·m (42 lb ft)	77 N·m (56 lb ft)	37 N·m (27 lb ft)	53 N·m (39 lb ft)
M12	70 N·m (52 lb ft)	93 N·m (69 lb ft)	100 N·m (74 lb ft)	134 N·m (98 lb ft)	63 N·m (47 lb ft)	91 N·m (67 lb ft)
M16	174 N·m (128 lb ft)	231 N·m (171 lb ft)	248 N·m (183 lb ft)	331 N·m (244 lb ft)	158 N·m (116 lb ft)	226 N·m (167 lb ft)
M20	350 N·m (259 lb ft)	467 N·m (345 lb ft)	484 N·m (357 lb ft)	645 N·m (476 lb ft)	318 N·m (235 lb ft)	440 N·m (325 lb ft)
M24	607 N·m (447 lb ft)	809 N·m (597 lb ft)	838 N·m (618 lb ft)	1118 N·m (824 lb ft)	552 N·m (407 lb ft)	

IDENTIFICATION**Metric Hex head and carriage bolts, classes 5.6 and up**

20083680 1

1. Manufacturer's Identification
2. Property Class

Metric Hex nuts and locknuts, classes 05 and up

20083681 2

1. Manufacturer's Identification
2. Property Class
3. Clock Marking of Property Class and Manufacturer's Identification (Optional), i.e. marks **60°** apart indicate Class 10 properties, and marks **120°** apart indicate Class 8.

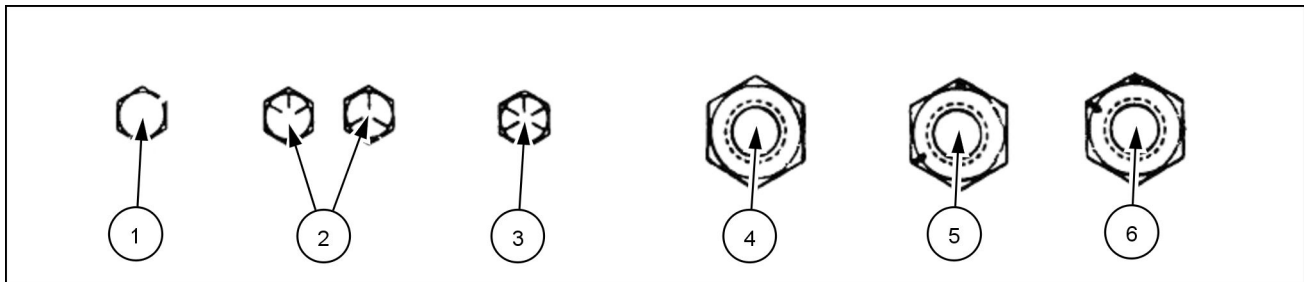
INCH NON-FLANGED HARDWARE

NOMINAL SIZE	SAE GRADE 5 BOLT and NUT		SAE GRADE 8 BOLT and NUT		LOCKNUT GrB W/ Gr5 BOLT	LOCKNUT GrC W/ Gr8 BOLT
	UN- PLATED or PLATED SILVER	PLATED W/ZnCr GOLD	UN- PLATED or PLATED SILVER	PLATED W/ZnCr GOLD		
1/4	8 N·m (71 lb in)	11 N·m (97 lb in)	12 N·m (106 lb in)	16 N·m (142 lb in)	8.5 N·m (75 lb in)	12.2 N·m (109 lb in)
5/16	17 N·m (150 lb in)	23 N·m (204 lb in)	24 N·m (212 lb in)	32 N·m (283 lb in)	17.5 N·m (155 lb in)	25 N·m (220 lb in)
3/8	30 N·m (22 lb ft)	40 N·m (30 lb ft)	43 N·m (31 lb ft)	57 N·m (42 lb ft)	31 N·m (23 lb ft)	44 N·m (33 lb ft)
7/16	48 N·m (36 lb ft)	65 N·m (48 lb ft)	68 N·m (50 lb ft)	91 N·m (67 lb ft)	50 N·m (37 lb ft)	71 N·m (53 lb ft)
1/2	74 N·m (54 lb ft)	98 N·m (73 lb ft)	104 N·m (77 lb ft)	139 N·m (103 lb ft)	76 N·m (56 lb ft)	108 N·m (80 lb ft)
9/16	107 N·m (79 lb ft)	142 N·m (105 lb ft)	150 N·m (111 lb ft)	201 N·m (148 lb ft)	111 N·m (82 lb ft)	156 N·m (115 lb ft)
5/8	147 N·m (108 lb ft)	196 N·m (145 lb ft)	208 N·m (153 lb ft)	277 N·m (204 lb ft)	153 N·m (113 lb ft)	215 N·m (159 lb ft)
3/4	261 N·m (193 lb ft)	348 N·m (257 lb ft)	369 N·m (272 lb ft)	491 N·m (362 lb ft)	271 N·m (200 lb ft)	383 N·m (282 lb ft)
7/8	420 N·m (310 lb ft)	561 N·m (413 lb ft)	594 N·m (438 lb ft)	791 N·m (584 lb ft)	437 N·m (323 lb ft)	617 N·m (455 lb ft)
1	630 N·m (465 lb ft)	841 N·m (620 lb ft)	890 N·m (656 lb ft)	1187 N·m (875 lb ft)	654 N·m (483 lb ft)	924 N·m (681 lb ft)

NOTE: For Imperial Units, **1/4 in** and **5/16 in** hardware torque specifications are shown in pound-inches. **3/8 in** through **1 in** hardware torque specifications are shown in pound-feet.

INCH FLANGED HARDWARE

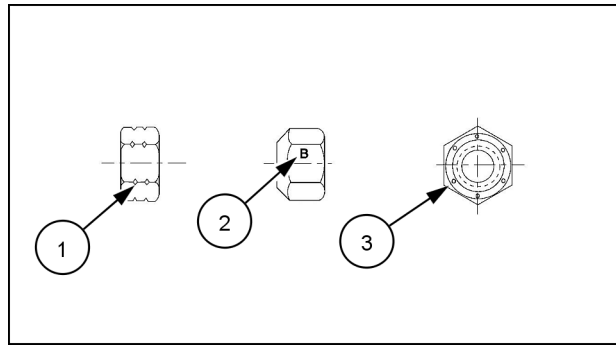
NOM- INAL SIZE	SAE GRADE 5 BOLT and NUT		SAE GRADE 8 BOLT and NUT		LOCKNUT GrF W/ Gr5 BOLT	LOCKNUT GrG W/ Gr8 BOLT
	UNPLATED or PLATED SILVER	PLATED W/ZnCr GOLD	UNPLATED or PLATED SILVER	PLATED W/ZnCr GOLD		
1/4	9 N·m (80 lb in)	12 N·m (106 lb in)	13 N·m (115 lb in)	17 N·m (150 lb in)	8 N·m (71 lb in)	12 N·m (106 lb in)
5/16	19 N·m (168 lb in)	25 N·m (221 lb in)	26 N·m (230 lb in)	35 N·m (310 lb in)	17 N·m (150 lb in)	24 N·m (212 lb in)
3/8	33 N·m (25 lb ft)	44 N·m (33 lb ft)	47 N·m (35 lb ft)	63 N·m (46 lb ft)	30 N·m (22 lb ft)	43 N·m (32 lb ft)
7/16	53 N·m (39 lb ft)	71 N·m (52 lb ft)	75 N·m (55 lb ft)	100 N·m (74 lb ft)	48 N·m (35 lb ft)	68 N·m (50 lb ft)
1/2	81 N·m (60 lb ft)	108 N·m (80 lb ft)	115 N·m (85 lb ft)	153 N·m (113 lb ft)	74 N·m (55 lb ft)	104 N·m (77 lb ft)
9/16	117 N·m (86 lb ft)	156 N·m (115 lb ft)	165 N·m (122 lb ft)	221 N·m (163 lb ft)	106 N·m (78 lb ft)	157 N·m (116 lb ft)
5/8	162 N·m (119 lb ft)	216 N·m (159 lb ft)	228 N·m (168 lb ft)	304 N·m (225 lb ft)	147 N·m (108 lb ft)	207 N·m (153 lb ft)
3/4	287 N·m (212 lb ft)	383 N·m (282 lb ft)	405 N·m (299 lb ft)	541 N·m (399 lb ft)	261 N·m (193 lb ft)	369 N·m (272 lb ft)
7/8	462 N·m (341 lb ft)	617 N·m (455 lb ft)	653 N·m (482 lb ft)	871 N·m (642 lb ft)	421 N·m (311 lb ft)	594 N·m (438 lb ft)
1	693 N·m (512 lb ft)	925 N·m (682 lb ft)	979 N·m (722 lb ft)	1305 N·m (963 lb ft)	631 N·m (465 lb ft)	890 N·m (656 lb ft)

IDENTIFICATION**Inch Bolts and free-spinning nuts**

20083682 3

Grade Marking Examples

SAE Grade Identification			
1	Grade 2 - No Marks	4	Grade 2 Nut - No Marks
2	Grade 5 - Three Marks	5	Grade 5 Nut - Marks 120° Apart
3	Grade 8 - Five Marks	6	Grade 8 Nut - Marks 60° Apart

Inch Lock Nuts, All Metal (Three optional methods)

20090268 4

Grade Identification

Grade	Corner Marking Method (1)	Flats Marking Method (2)	Clock Marking Method (3)
Grade A	No Notches	No Mark	No Marks
Grade B	One Circumferential Notch	Letter B	Three Marks
Grade C	Two Circumferential Notches	Letter C	Six Marks

Torque - Standard torque data for hydraulics

1650M

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NOTICE: Hydraulic connections require a minimum assembly torque in order to provide zero leakage at rated pressure with adequate fatigue resistance. Too much torque on a hydraulic connection can lead to leakage or failure.

NOTICE: There are several different kinds of parallel thread ports, including those using metric threads, inch threads, and British Standard Pipe Parallel (BSPP) threads. None of these port systems are interchangeable, and using the wrong connector in a port will not provide an adequate seal, even if it is possible to install the part.

NOTE: Hand install and hand tighten all connections before using tools to set the torque. This will reduce the possibility of thread damage.

Torques for Metric O-Ring Boss (ORB) stud ends and port connections

Metric Thread	S-Series (Heavy Duty)		L-Series (Light Duty)	
	Ferrous	Non-Ferrous	Ferrous	Non-Ferrous
M8x1	10.5 N·m (7.7 lb ft)	6.3 N·m (4.6 lb ft)	8.5 N·m (6.3 lb ft)	5 N·m (3.7 lb ft)
M10x1	21 N·m (15.5 lb ft)	12.5 N·m (9.2 lb ft)	15.5 N·m (11.4 lb ft)	9.3 N·m (6.9 lb ft)
M12x1.5	37 N·m (27.3 lb ft)	22 N·m (16.2 lb ft)	27 N·m (19.9 lb ft)	16 N·m (11.8 lb ft)
M14x1.5	47 N·m (34.7 lb ft)	28 N·m (20.7 lb ft)	37 N·m (27.3 lb ft)	22 N·m (16.2 lb ft)
M16x1.5	58 N·m (42.8 lb ft)	35 N·m (25.8 lb ft)	42 N·m (31.0 lb ft)	25 N·m (18.4 lb ft)
M18x1.5	74 N·m (54.6 lb ft)	44 N·m (32.5 lb ft)	47 N·m (34.7 lb ft)	28 N·m (20.7 lb ft)
M22x1.5	105 N·m (77.4 lb ft)	63 N·m (46.5 lb ft)	63 N·m (46.5 lb ft)	38 N·m (28.0 lb ft)
M27x2	178 N·m (131.3 lb ft)	107 N·m (78.9 lb ft)	105 N·m (77.4 lb ft)	63 N·m (46.5 lb ft)
M30x2	225 N·m (166.0 lb ft)	135 N·m (99.6 lb ft)	136 N·m (100.3 lb ft)	82 N·m (60.5 lb ft)
M33x2	325 N·m (239.7 lb ft)	195 N·m (143.8 lb ft)	168 N·m (123.9 lb ft)	101 N·m (74.5 lb ft)
M42x2	345 N·m (254.5 lb ft)	207 N·m (152.7 lb ft)	220 N·m (162.3 lb ft)	132 N·m (97.4 lb ft)
M48x2	440 N·m (324.5 lb ft)	264 N·m (194.7 lb ft)	273 N·m (201.4 lb ft)	164 N·m (121.0 lb ft)
M60x2	525 N·m (387.2 lb ft)	315 N·m (232.3 lb ft)	330 N·m (243.4 lb ft)	198 N·m (146.0 lb ft)

NOTE: Final torque tolerance +/- 10% of the given torque specification.

Torques for Metric O-Ring Boss (ORB) port plugs

Metric Thread	Ferrous		Non-Ferrous
	Internal Hex	External Hex	
M8x1	8.5 N·m (6.3 lb ft)	10.5 N·m (7.7 lb ft)	6.3 N·m (4.6 lb ft)
M10x1	16 N·m (11.8 lb ft)	21 N·m (15.5 lb ft)	12.5 N·m (9.2 lb ft)
M12x1.5	23 N·m (17.0 lb ft)	37 N·m (27.3 lb ft)	22 N·m (16.2 lb ft)
M14x1.5	47 N·m (34.7 lb ft)		28 N·m (20.7 lb ft)
M16x1.5	58 N·m (42.8 lb ft)		35 N·m (25.8 lb ft)
M18x1.5	74 N·m (54.6 lb ft)		44 N·m (32.5 lb ft)
M22x1.5	105 N·m (77.4 lb ft)		63 N·m (46.5 lb ft)
M27x2	178 N·m (131.3 lb ft)		107 N·m (78.9 lb ft)
M30x2	225 N·m (166.0 lb ft)		135 N·m (99.6 lb ft)
M33x2	325 N·m (239.7 lb ft)		195 N·m (143.8 lb ft)
M42x2	345 N·m (254.5 lb ft)		207 N·m (152.7 lb ft)
M48x2	440 N·m (324.5 lb ft)		264 N·m (194.7 lb ft)
M60x2	525 N·m (387.2 lb ft)		315 N·m (232.3 lb ft)

NOTE: Final torque tolerance +/- 10% of the given torque specification.

Torques for British Standard Pipe Parallel (BSPP) straight-pipe-thread port connections

BSPP Thread	Metric Tube OD		Ferrous		Non-Ferrous	
	S-Series (Heavy Duty)	L-Series (Light Duty)	S-Series (Heavy Duty)	L-Series (Light Duty)	S-Series (Heavy Duty)	L-Series (Light Duty)
G 1/8 A	—	6 mm	—	21 N·m (15.5 lb ft)	—	12.5 N·m (9.2 lb ft)
G 1/4 A	6 mm	8 mm	63 N·m (46.5 lb ft)	53 N·m (39.1 lb ft)	38 N·m (28.0 lb ft)	32 N·m (23.6 lb ft)
	8 mm	10 mm				
G 3/8 A	10 mm	12 mm	95 N·m (70.1 lb ft)	84 N·m (62.0 lb ft)	57 N·m (42.0 lb ft)	50 N·m (36.9 lb ft)
	12 mm					
G 1/2 A	16 mm	15 mm	136 N·m (100.3 lb ft)	105 N·m (77.4 lb ft)	82 N·m (60.5 lb ft)	63 N·m (46.5 lb ft)
		18 mm				
G 3/4 A	20 mm	22 mm	210 N·m (154.9 lb ft)	210 N·m (154.9 lb ft)	126 N·m (92.9 lb ft)	126 N·m (92.9 lb ft)
G 1 A	25 mm	28 mm	400 N·m (295.0 lb ft)	400 N·m (295.0 lb ft)	240 N·m (177.0 lb ft)	240 N·m (177.0 lb ft)
G 1-1/4 A	30 mm	35 mm	525 N·m (387.2 lb ft)	525 N·m (387.2 lb ft)	315 N·m (232.3 lb ft)	315 N·m (232.3 lb ft)
G 1-1/2 A	38 mm	42 mm	660 N·m (486.8 lb ft)	660 N·m (486.8 lb ft)	396 N·m (292.1 lb ft)	396 N·m (292.1 lb ft)

NOTE: Final torque tolerance is +/- 10% of the given torque specification.

INTRODUCTION

Torques for Metric O-Ring Face Seal (ORFS) ports and stud end connections

BSP Thread	Metric Tube OD		Ferrous		Non-Ferrous	
	S-Series (Heavy Duty)	L-Series (Light Duty)	S-Series (Heavy Duty)	L-Series (Light Duty)	S-Series (Heavy Duty)	L-Series (Light Duty)
M10x1	—	4 mm	—	21 N·m (15.5 lb ft)	—	12.5 N·m (9.2 lb ft)
M12x1.5	4 mm	6 mm	47 N·m (34.7 lb ft)	32 N·m (23.6 lb ft)	28 N·m (20.7 lb ft)	19 N·m (14.0 lb ft)
M14x1.5	5 mm	7 mm	63 N·m (46.5 lb ft)	53 N·m (39.1 lb ft)	38 N·m (28.0 lb ft)	32 N·m (23.6 lb ft)
M16x1.5	7 mm	9 mm	84 N·m (62.0 lb ft)	63 N·m (46.5 lb ft)	50 N·m (36.9 lb ft)	38 N·m (28.0 lb ft)
M18x1.5	8 mm	11 mm	105 N·m (77.4 lb ft)	84 N·m (62.0 lb ft)	63 N·m (46.5 lb ft)	50 N·m (36.9 lb ft)
M20x1.5	10 mm	—	147 N·m (108.4 lb ft)	—	88 N·m (64.9 lb ft)	—
M22x1.5	12 mm	14 mm	158 N·m (116.5 lb ft)	147 N·m (108.4 lb ft)	95 N·m (70.1 lb ft)	88 N·m (64.9 lb ft)
M26x1.5	—	18 mm	—	210 N·m (154.9 lb ft)	—	126 N·m (92.9 lb ft)
M27x1.2	16 mm	—	210 N·m (154.9 lb ft)	—	126 N·m (92.9 lb ft)	—
M33x2	20 mm	23 mm	400 N·m (295.0 lb ft)	400 N·m (295.0 lb ft)	240 N·m (177.0 lb ft)	240 N·m (177.0 lb ft)
M42x2	25 mm	30 mm	525 N·m (387.2 lb ft)	525 N·m (387.2 lb ft)	315 N·m (232.3 lb ft)	315 N·m (232.3 lb ft)
M48x2	32 mm	36 mm	630 N·m (464.7 lb ft)	630 N·m (464.7 lb ft)	396 N·m (292.1 lb ft)	396 N·m (292.1 lb ft)

NOTE: Final torque tolerance +/- 10% of the given torque specification.

Torques for Inch O-Ring Boss (ORB) non-adjustable port and stud end connections

SAE Dash size	UN/UNF Thread size	Inch Tube OD	S-Series (Heavy Duty)		L-Series (Light Duty)	
			Ferrous	Non-Ferrous	Ferrous	Non-Ferrous
2	5/16–24	3.18 mm (0.125 in) 1/8	—	—	8.5 N·m (6.3 lb ft)	5 N·m (3.7 lb ft)
3	3/8–24	4.76 mm (0.187 in) 3/16	15.5 N·m (11.4 lb ft)	9.3 N·m (6.9 lb ft)	10.5 N·m (7.7 lb ft)	6.3 N·m (4.6 lb ft)
4	7/16–20	6.35 mm (0.25 in) 1/4	37 N·m (27.3 lb ft)	22 N·m (16.2 lb ft)	19 N·m (14.0 lb ft)	11.5 N·m (8.5 lb ft)
5	1/2–20	7.94 mm (0.313 in) 5/16	42 N·m (31.0 lb ft)	25 N·m (18.4 lb ft)	26 N·m (19.2 lb ft)	15.5 N·m (11.4 lb ft)
6	9/16–18	9.52 mm (0.375 in) 3/8	47 N·m (34.7 lb ft)	28 N·m (20.7 lb ft)	32 N·m (23.6 lb ft)	19 N·m (14.0 lb ft)
8	3/4–16	12.7 mm (0.5 in) 1/2	89 N·m (65.6 lb ft)	53 N·m (39.1 lb ft)	53 N·m (39.1 lb ft)	32 N·m (23.6 lb ft)
10	7/8–14	15.88 mm (0.625 in) 5/8	121 N·m (89.2 lb ft)	73 N·m (53.8 lb ft)	63 N·m (46.5 lb ft)	38 N·m (28.0 lb ft)
12	1-1/16–12	19.05 mm (0.75 in) 3/4	178 N·m (131.3 lb ft)	107 N·m (78.9 lb ft)	100 N·m (73.8 lb ft)	60 N·m (44.3 lb ft)
14	1-3/16–12	22.22 mm (0.875 in) 7/8	225 N·m (166.0 lb ft)	135 N·m (99.6 lb ft)	131 N·m (96.6 lb ft)	79 N·m (58.3 lb ft)
16	1-5/16–12	25.4 mm (1.0 in) 1	283 N·m (208.7 lb ft)	170 N·m (125.4 lb ft)	156 N·m (115.1 lb ft)	94 N·m (69.3 lb ft)
20	1-5/8–12	31.75 mm (1.25 in) 1-1/4	300 N·m (221.3 lb ft)	180 N·m (132.8 lb ft)	210 N·m (154.9 lb ft)	126 N·m (92.9 lb ft)
24	1-7/8–12	38.1 mm (1.5 in) 1-1/2	388 N·m (286.2 lb ft)	233 N·m (171.9 lb ft)	220 N·m (162.3 lb ft)	132 N·m (97.4 lb ft)
32	2-1/2–12	50.8 mm (2.0 in) 2	388 N·m (286.2 lb ft)	233 N·m (171.9 lb ft)	315 N·m (232.3 lb ft)	189 N·m (139.4 lb ft)

NOTE: Final torque tolerance +/- 10% of the given torque specification.

Torques for Inch O-Ring Boss (ORB) adjustable stud end and port connections

SAE Dash size	UN/UNF Thread size	Inch Tube OD	S-Series (Heavy Duty)		L-Series (Light Duty)	
			Ferrous	Non-Ferrous	Ferrous	Non-Ferrous
2	5/16–24	3.18 mm (0.125 in) 1/8	—	—	8.5 N·m (6.3 lb ft)	5 N·m (3.7 lb ft)
3	3/8–24	4.76 mm (0.187 in) 3/16	10.5 N·m (7.7 lb ft)	9.3 N·m (6.9 lb ft)	10.5 N·m (7.7 lb ft)	6.3 N·m (4.6 lb ft)
4	7/16–20	6.35 mm (0.25 in) 1/4	21 N·m (15.5 lb ft)	21 N·m (15.5 lb ft)	19 N·m (14.0 lb ft)	11.5 N·m (8.5 lb ft)
5	1/2–20	7.94 mm (0.313 in) 5/16	42 N·m (31.0 lb ft)	25 N·m (18.4 lb ft)	26 N·m (19.2 lb ft)	15.5 N·m (11.4 lb ft)
6	9/16–18	9.52 mm (0.375 in) 3/8	47 N·m (34.7 lb ft)	28 N·m (20.7 lb ft)	32 N·m (23.6 lb ft)	19 N·m (14.0 lb ft)
8	3/4–16	12.7 mm (0.5 in) 1/2	89 N·m (65.6 lb ft)	53 N·m (39.1 lb ft)	53 N·m (39.1 lb ft)	32 N·m (23.6 lb ft)
10	7/8–14	15.88 mm (0.625 in) 5/8	121 N·m (89.2 lb ft)	73 N·m (53.8 lb ft)	63 N·m (46.5 lb ft)	38 N·m (28.0 lb ft)
12	1-1/16–12	19.05 mm (0.75 in) 3/4	178 N·m (131.3 lb ft)	107 N·m (78.9 lb ft)	100 N·m (73.8 lb ft)	60 N·m (44.3 lb ft)
14	1-3/16–12	22.22 mm (0.875 in) 7/8	225 N·m (166.0 lb ft)	135 N·m (99.6 lb ft)	131 N·m (96.6 lb ft)	79 N·m (58.3 lb ft)
16	1-5/16–12	25.4 mm (1.0 in) 1	285 N·m (210.2 lb ft)	170 N·m (125.4 lb ft)	156 N·m (115.1 lb ft)	94 N·m (69.3 lb ft)
20	1-5/8–12	31.75 mm (1.25 in) 1-1/4	300 N·m (221.3 lb ft)	180 N·m (132.8 lb ft)	210 N·m (154.9 lb ft)	126 N·m (92.9 lb ft)
24	1-7/8–12	38.1 mm (1.5 in) 1-1/2	388 N·m (286.2 lb ft)	233 N·m (171.9 lb ft)	220 N·m (162.3 lb ft)	132 N·m (97.4 lb ft)
32	2-1/2–12	50.8 mm (2.0 in) 2	388 N·m (286.2 lb ft)	233 N·m (171.9 lb ft)	315 N·m (232.3 lb ft)	189 N·m (139.4 lb ft)

NOTE: Final torque tolerance $\pm 10\%$ of the given torque specification.

INTRODUCTION

Torques for Inch O-Ring Boss (ORB) port plug

SAE Dash size	UN/UNF Thread size	Ferrous		Non-Ferrous
		Internal Hex	External Hex	
2	5/16-24	7.5 N·m (5.5 lb ft)	12.5 N·m (9.2 lb ft)	7.5 N·m (5.5 lb ft)
3	3/8-24	14.5 N·m (10.7 lb ft)	21 N·m (15.5 lb ft)	12.5 N·m (9.2 lb ft)
4	7/16-20	21 N·m (15.5 lb ft)	37 N·m (27.3 lb ft)	22 N·m (16.2 lb ft)
5	1/2-20	28 N·m (20.7 lb ft)	42 N·m (31.0 lb ft)	25 N·m (18.4 lb ft)
6	9/16-18	47 N·m (34.7 lb ft)	47 N·m (34.7 lb ft)	28 N·m (20.7 lb ft)
8	3/4-16	89 N·m (65.6 lb ft)	89 N·m (65.6 lb ft)	53 N·m (39.1 lb ft)
10	7/8-14	116 N·m (85.6 lb ft)	116 N·m (85.6 lb ft)	70 N·m (51.6 lb ft)
12	1-1/16-12	176 N·m (129.8 lb ft)	176 N·m (129.8 lb ft)	106 N·m (78.2 lb ft)
14	1-3/16-12	247 N·m (182.2 lb ft)	247 N·m (182.2 lb ft)	148 N·m (109.2 lb ft)
16	1-5/16-12	284 N·m (209.5 lb ft)	284 N·m (209.5 lb ft)	170 N·m (125.4 lb ft)
20	1-5/8-12	357 N·m (263.3 lb ft)	357 N·m (263.3 lb ft)	214 N·m (157.8 lb ft)
24	1-7/8-12	441 N·m (325.3 lb ft)	441 N·m (325.3 lb ft)	265 N·m (195.5 lb ft)
32	2-1/2-12	536 N·m (395.3 lb ft)	536 N·m (395.3 lb ft)	322 N·m (237.5 lb ft)

NOTE: Final torque tolerance +/- 10% of the given torque specification.

INTRODUCTION

Torques for O-Ring Face Seal (ORFS) hose connectors

SAE Dash size	UN/UNF Thread size	Tube OD	High/Medium pressure applications (greater than 50 bar (725 psi))	Low pressure applications (less than 50 bar (725 psi))
			Swivel nut torque	
4	9/16–18	6.35 mm (0.25 in) 1/4	27 N·m (19.9 lb ft)	27 N·m (19.9 lb ft)
5	5/8–18	7.94 mm (0.313 in) 5/16	34 N·m (25.1 lb ft)	34 N·m (25.1 lb ft)
6	11/16–16	9.52 mm (0.375 in) 3/8	44 N·m (32.5 lb ft)	44 N·m (32.5 lb ft)
8	13/16–16	12.7 mm (0.5 in) 1/2	65 N·m (47.9 lb ft)	65 N·m (47.9 lb ft)
10	1–14	15.88 mm (0.625 in) 5/8	100 N·m (73.8 lb ft)	100 N·m (73.8 lb ft)
12	1-3/16–12	19.05 mm (0.75 in) 3/4	150 N·m (110.6 lb ft)	131 N·m (96.6 lb ft)
14	1-5/16–12	22.22 mm (0.875 in) 7/8	163 N·m (120.2 lb ft)	131 N·m (96.6 lb ft)
16	1-7/16–12	25.4 mm (1.0 in) 1	210 N·m (154.9 lb ft)	131 N·m (96.6 lb ft)
20	1-11/16–12	31.75 mm (1.25 in) 1-1/4	280 N·m (206.5 lb ft)	178 N·m (131.3 lb ft)
24	2–12	38.1 mm (1.5 in) 1-1/2	375 N·m (276.6 lb ft)	210 N·m (154.9 lb ft)

NOTE: Final torque tolerance +/- 10% of the given torque specification.

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